# Commercialisation of PORTSIM Research Projects in China

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## INTRODUCTION

The Palm Oil Research and Technical Service Institute of MPOB (PORTSIM) was established in 2005 in Shanghai, China to enhance Malaysian palm oil's presence and establish closer ties with the oils and fats industry in China. The other objectives of PORTSIM are to expand the applications of palm oil in food and non-food products and to increase the imports of Malaysian palm oil products into China. In order to engage with the local companies to use more palm oil products, PORTSIM has established technical collaborations with Chinese universities, research institutes and enterprises. PORTSIM is also equipped with research and analytical facilities to conduct research projects. The three-party research collaboration involving PORTSIM, local companies and universities or research institutes ensures that newly developed products from the research projects are ready for commercialisation at the completion of the projects. Some of the completed and commercialised projects were:

- vegetable lard for bakery products;
- palm-based special oils for quick-frozen food and frozen bread dough;
- frying oils for local fast food industry; and
- Palm kernel cake (PKC) for cattle and aquaculture industry.

## VEGETABLE LARD IN BAKERY PRODUCTS

This project was conducted in collaboration with Changsha University of Science and Technology and a local company to produce vegetable lard. The objectives of the project were to develop a vegetable lard for bakery products based on palm oil or mixture of palm oil and lard, and to replace lard (totally or partially) in bakery food applications, especially in Chinese traditional cookies. Fat is one of the main ingredients in baking and lard is widely used in China. In the local food market, lard is used as an ingredient fat in Chinese traditional food as well as cooking fat in homes and restaurants, instant noodles, frozen foods, *etc*. It has special functionalities in bakery foods such plasticity, dispersion, ductility, plasticity, holding water property, crisp, oily property and distinct flavour. Lard is applied to many food products such as Jingbajian, Peach crisp, Wife cake, Crystal cake, Lard cake, Shaobing, *etc*. Lard is widely used as a cooking fat in Jiangxi, Hunan, Hubei, Sichuan, Chongqing and Guizhou provinces, which makes up about 29% of the total population in China. It is more acceptable than other edible oils by majority of these provinces due to its distinct flavour.

Palm oil has similar fatty acid compositions and properties as lard but there are some differences. The main differences are that lard has a unique flavour, contains cholesterol, possesses ß crystal tendency and turns rancid easily. However, palm oil possesses glossy ß'crystal tendency, good oxidative stability, higher level of C16 acids, natural, semi-solid consistency, and less flavour reversion, *etc*. From the nutri-

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tional point of view, palm oil vegetable lard substitute or mixture of palm oil and lard offers a healthier substitute for lard. Palm oil being composed of equal proportions of saturated and unsaturated fatty acid with a sufficient amount of essential fatty acid is easily digested and absorbed. The use of palm oil also helps to reduce the level of *trans* fatty acids. Vegetable lard can be used to partially or totally replace the lard currently used in bakery products. The Chinese consume more than 3.0 million tonnes of lard annually and more than 20% of the lard is used in making Chinese traditional foods.

Two formulations based on palm olein, palm stearin and soyabean oil was found to be suitable replacement for the vegetable lard (*Table 1*). Palm-based vegetable lard is better than lard in terms of nutritional values and functionality such as:

- better oxidative stability;
- lower cholesterol content;
- higher vitamin E content;
- better crystal structure for good appearance and functionality; and
- price advantage.

Traditional Chinese cookies made with the palm-based vegetable lard were comparable with those made with lard. These palm-based vegetable lard are available commercially and are now being used by a number of local companies in producing Chinese cookies (*Figure 1*).

## PALM-BASED SPECIAL OILS FOR QUICK-FROZEN FOOD AND FROZEN BREAD DOUGH

This project was conducted in collaboration with Henan University of Technology and local companies to produce palm-based special oils for quick-frozen food and frozen bread dough and introduce the new product to Chinese quick-frozen food manufacturers and bread manufacturers.

**TABLE 1. PALM-BASED VEGETABLE LARD FORMULATION**

| Formulation | Palm stearin (%) | Palm olein (%) | Soyabean oil (%) |
|---|---|---|---|
| 1 | 33 | 67 | - |
| 2 | 24 | 56 | 20 |

*Figure 1. Cookies made from palm-based vegetable lard.*

China's quick-frozen food industry is one of the fastest growing food industries in the country. The industry has developed very rapidly since 1990's, with the output growing by 20% per year, and the sales increasing by 15% annually. It also can be seen from *Figure 2* that the volume of quick-frozen food in China's market has grown rapidly, increasing from 14 million tonnes in 1997 to 38 million tonnes in 2008. The growth is expected to continue as the living standard in China is improving every year. Quick-frozen food made of wheat flour and rice (QFFWFR) is the major product in China's quick-frozen food market with market share of 60%-70%. The main varieties of QFFWFR with high usage of oil in China's market are shown in *Table 2*. In this project, PORTSIM developed palm-based special oils for these QFFWFR as ingredients for stuffing and pastry.

Although the quick-frozen food industry is developing rapidly, the average per capita consumption in China of 10 kg is far lower than that in developed countries (20-80 kg), as shown in *Figure 3*. There is huge market potential for quick-frozen food in China.

A number of formulations were prepared and the most suitable formulation was palm stearin (melting point of 52°C) and palm olein (melting point of 14°C) mixed at the ratio of 50:50. Emulsifers such as glyceryl monosterate (GMS) and trimethylene glycol ester (TGE) were added and the mixture processed through the following operations to produce the palm-based special oil (*Figure 4*).

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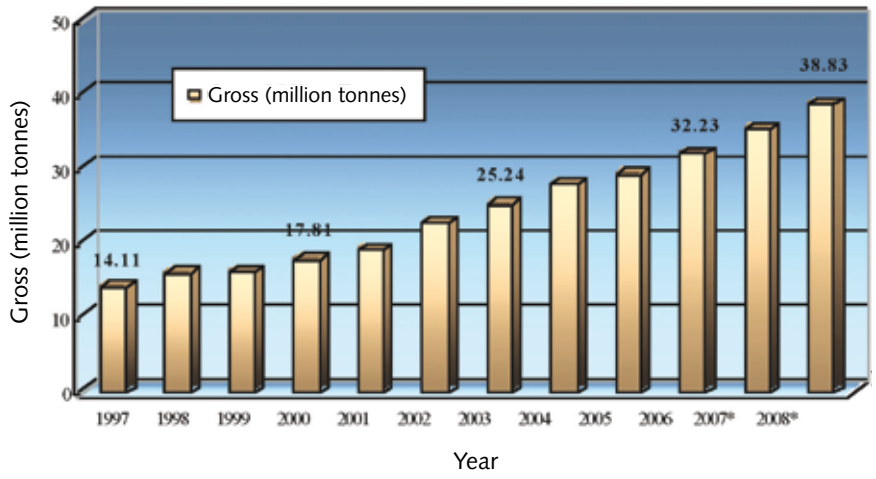



Source: Market Modernisation (2006).

*Figure 2. Gross quick-frozen food in China's market.*

**TABLE 2. MAIN VARIETIES OF QUICK-FROZEN FOOD MADE OF WHEAT FLOUR AND RICE (QFFWFR) IN CHINA'S MARKET***

| Variety | Market share (%) |
|---|---|
| Quick-frozen boiled dumpling | 37.8 |
| Quick-frozen stuffed dumpling ball | 23.4 |
| Quick-frozen wonton | 7.4 |
| Quick-frozen steamed stuffed bun | 6.2 |
| Quick-frozen steamed bread | 5.0 |
| Quick-frozen steamed open dumplings | 3.8 |
| Quick-frozen steamed twisted roll | 3.6 |
| Quick-frozen spring rolls | 2.6 |
| Other types of QFFWFR | 10.0 |
| Total | 100 |

Note: *Estimated according to quick-frozen food market of major Chinese cities.

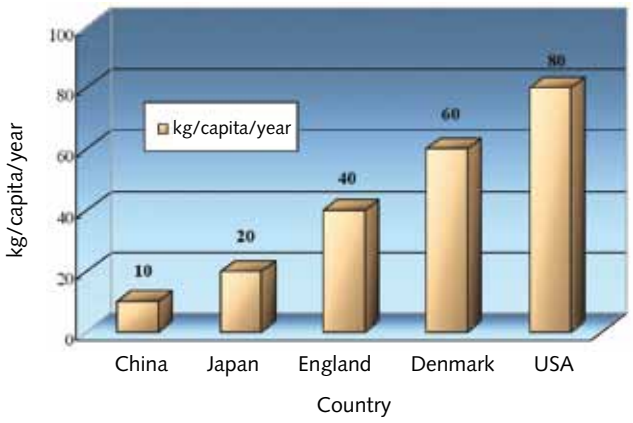
This palm-based special oil was used in the producing of the following products such as quick-frozen stuffed dumpling balls and frozen bread dough (*Figures 5* and *6*). A local company is currently producing the commercial palm-based special oil for quick frozen food manufacturers.

## FRYING OILS FOR LOCAL FAST FOOD INDUSTRY

This project was conducted in collaboration with a local fast food company with over 130 chain restaurants throughout China. The objective of the project was to develop the palm-based frying oil for the Chinese fast food industry.

Frying is the most widely used cooking process in the fast food industry. It is quick, easily adaptable to mass production and produced tasty products of attractive appearance and good oxidative stability. The function of an oil or fat used in frying is to act as a heat transfer medium. It also brings out the flavour. In the commercial and industrial food industries deep frying is the norm. The followings are the important attributes of deep frying oils:

- high resistance to oxidation and gumming;
- low free fatty acid (FFA) rise (and smoking);
- low rate of foaming;
- low rate of darkening;
- low melting point (except for special purpose); and
- nutritionally good fatty acid composition.




Source: Science and Technology of Cereals, Oils and Foods (2005).

*Figure 3. Average per capita consumption of quick-frozen food (estimated in 2006).*

**Water**
↓
**Emulsifier → Oil phase → Mixed → Pre-heat → Stirring Emulsifying → Precooling → Quench kneading → Maturing Aging → Finish Product**

*Figure 4. Process technology for palm-based special oil.*

In Malaysia and other South-East Asian countries, palm-based frying oils are widely used by the multinational Fast Food Chains (FFC) as their frying and baking media for the preparation of fast foods. However, this is still not so popular with the local food industry in China. The most popular frying oils used in China are soyabean oil and rapeseed oil. The consumption of edible oils in China was about 33 million tonnes in 2011. More than 32% of it was soyabean oil (10.8 million tonnes) and is widely used for cooking and frying in restaurants and households.

This fast food company has been using soyabean oil all along in frying their main product - Chinese dough-sticks. Various blends of palm olein and soyabean oil were formulated for the experiments. The results showed that lower melting point palm olein, palm superolein or blends with soyabean oil are suitable for frying the dough-sticks. The appearance and taste of dough-sticks fried using these blended oil were the same as soyabean oil. However, palm oil and palm stearin are not suitable for frying dough-sticks because it does not produce a fried dough-sticks with a soft enough interior texture. The dough sticks fried at 200°C were found to have good expansion and optimum colour compared to frying at higher or lower temperatures. It was also observed that the rate of FFA increase in palm superolein was slightly higher than that of soyabean oil. However, the FFA of the two oils was far below 2.5% (FFA limit). The PV increase slower in palm superolein than in soyabean oil.

*Figure 5. Quick-frozen stuffed dumpling balls.*

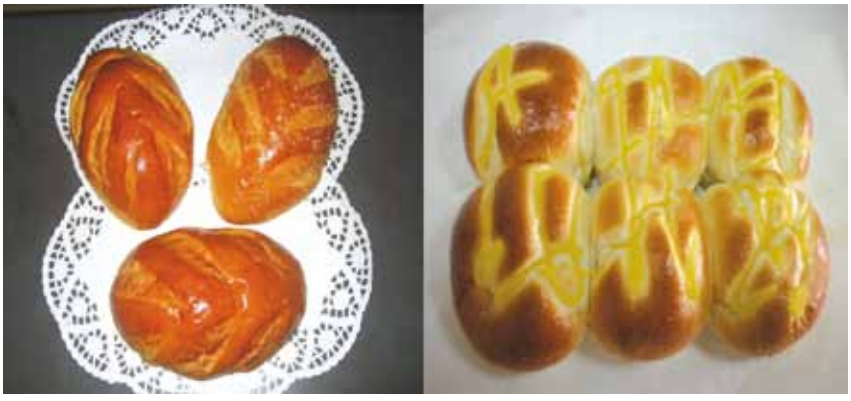


*Figure 6. Frozen bread dough.*

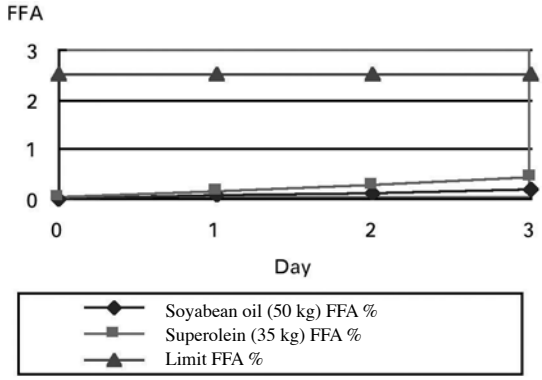



*Figure 7. Changes in FFA of soyabean oil and palm superolein during the frying progress.*

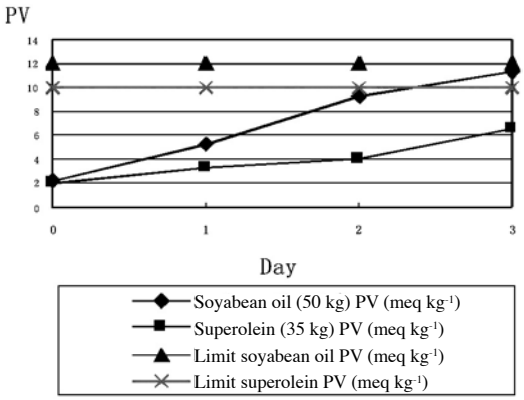



*Figure 8. Changes in PV of soyabean oil and palm superolein during the frying progress.*

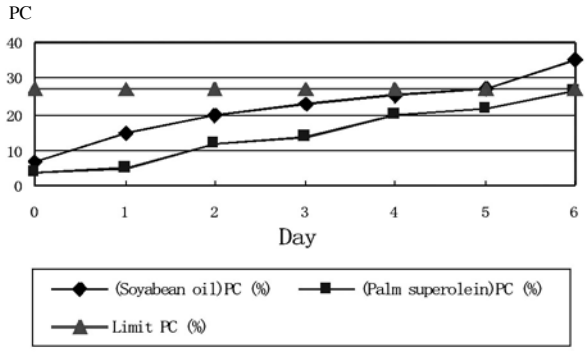



*Figure 9. Changes in PC of soyabean oil and palm superolein during frying progress.*

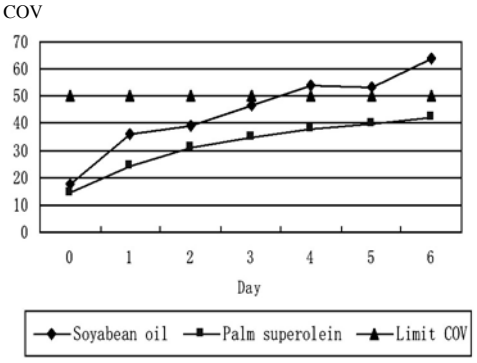



*Figure 10. Changes in COV of soyabean oil and palm superolein during frying progress.*

*Figure 11. Chinese fried dough stick.*

It was found that the increase in the colour of the frying oil was significantly faster in palm superolein than that of soyabean oil (*Table 3*). The content of the polymer compounds (PC) and carbonyl value (COV) in palm olein were lower compared to that of the soyabean oil. Palm superolein also has a better oxidative stability as compared to soyabean oil (*Figures 7 to 10*).

The company has accepted palm superolein as their frying oil and the local refineries are producing the superolein for them. At the same time, the local refineries are also producing blend of palm superolein and soyabean oil for local restaurant usage.

**PALM KERNEL CAKE (PKC) FOR BEEF AND DAIRY CATTLE AND AQUACULTURE**

This cattle project was conducted in collaboration with Beef Cattle Research Center, of China Agricultural University and aquaculture with Ocean University of China. In Korea and EU, palm kernel cake (PKC) is widely used as animal feed and for producing compound feed. However in China, PKC was hardy used until much recently. The main feed products are soyabean meal, corn and other feed additives. China's growing livestock industry has boosted its feed industry. In 2011, total feed production was 169 million tonnes. In China, the number of cattle raised was over 100 million in 2011. Dairy cattle accounts for about 13 million and beef cattle are over 50 million.

In the beef cattle project, the experiment was conducted through a 12-week feeding trial using 45 Simmental x Mongolian Cattle F1 cross-bred bulls (*Figure 12*). The objective was to investigate the effect of PKC on the growth performance and feed cost. Three treatment diets used: 1) control diet with no PKC addition, 2) diet with 20% PKC supplement in mixed concentrate, and 3) diet with 40% PKC supplement in mixed concentrate. Results showed that diets with different PKC supplemented levels were acceptable to the animals, when PKC inclusion diets were treated with natural fermentation for 18-24 hr. Supplements of 20% and 40% PKC in the mixed concentrate had no significant effect ($p>0.19$) on daily gain, dry matter intake and feed conversion efficiency. When PKC was supplemented in the diet at up to 20%-40% of mixed concentrate, there was no adverse effect on growth performance but the feed cost per unit body weight gain was reduced between RMB0.665 and RMB1.593.

For the dairy cow trial, 30 Holstein cows were used in a 12-week lactation trial (*Figure 13)*. Three treatment diets used: 1) control diet with no PKC included in the concentrate diet; 2) 12% PKC diet with replacing corn and soyabean meal by PKC; and 3) 24% PKC diet. The result showed that, compared with the control, PKC inclusion levels at 12%-24% had no impaired effect on milk yield, composition and dietary dry matter intake, but reduced feed costs per

**TABLE 3. THE COLOUR OF FRYING OIL: COMPARISON**

| Day | Soyabean oil | Palm superolein |
|---|---|---|
| 0 | R 1.0 Y 9.0 (5¼") | R 2.8 Y 22 W 0.1 (5¼") |
| 1 | R 2.1 Y 20 (5¼") | R 14.5 Y 79 (5¼") |
| 2 | R 4.0 Y 40 (5¼") | R 5.3 Y 54 (1") |
| 3 | R 1.0 Y 10 (1") | R 7.9 Y 70 (1") |
| 4 | R 2.0 Y 20 (1") | R 12 Y 79 (1") |
| 5 | R 3.0 Y 30 (1") | R 14 Y 79 (1") |
| 6 | R 4.0 Y 47 W 0.1 (1") | R 19.9 Y 79 (1") |

*Figure 12. Beef cattle.*

kg milk between 0.064 yuan and 0.130 yuan. The results showed that PKC can be utilised as an alternative feedstuff source to dairy cows.

China is the world largest producer of aquaculture products and largest exporter of fish in the world. It consumed 20% of the world's fishmeal supplies. The main ingredients for aquaculture feed are soyabean meal, fishmeal, corn flour, rapeseed meal and cottonseed meal. The objective of the project was to utilise PKC as an ingredient in aquaculture feed. In the experiment, palm kernel meal (PKM) was supplemented in a commercial diet to evaluate the effect on growth, feed utilisation, body composition, serologic index of juvenile Nile tilapia. There are no significant difference *in vitro* pepsinum digestibility (P>0.05). In feeding experiments, growth performance, feed conversion ratio, body protein composition and serologic index of juvenile Nile tilapia were not effected when PKM was added up to 6%(P>0.05). The results showed that PKC can be added into fish feed diets up to 6%.

China started to import PKC since 2008 and the volume has increased considerably (*Table 4*). However, in late 2010 and 2011 the price of PKC increased by more than 100% and this has reduced the import of PKC for animal feed.

## CONCLUSION

The various projects conducted by PORTSIM have resulted in the increased usage of palm oil products in China. The project on frying oils for fast food Industry, palm-based vegetable lard in bakery products and palm-based special oils for quick-frozen food has resulted in partial or total replacement of soyabean oil and lard by palm-based products. These have also lowered the cost of raw materials for the manufacturers and extended the utilisation of palm oil in the Chinese food industry. The project on the application and utilisation of PKC in the feed cattle and aquaculture industry will lower the cost of animal feed formulations for the feed manufacturers.

*Figure 13. Dairy cattle.*

**TABLE 4. EXPORT OF PKC TO CHINA (t)**

| Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|
| Volume | 0 | 16 | 11 947 | 253 663 | 227 007 | 99 239 |

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